



# Taming the data wilderness with the VHO: Integrating heliospheric data sets

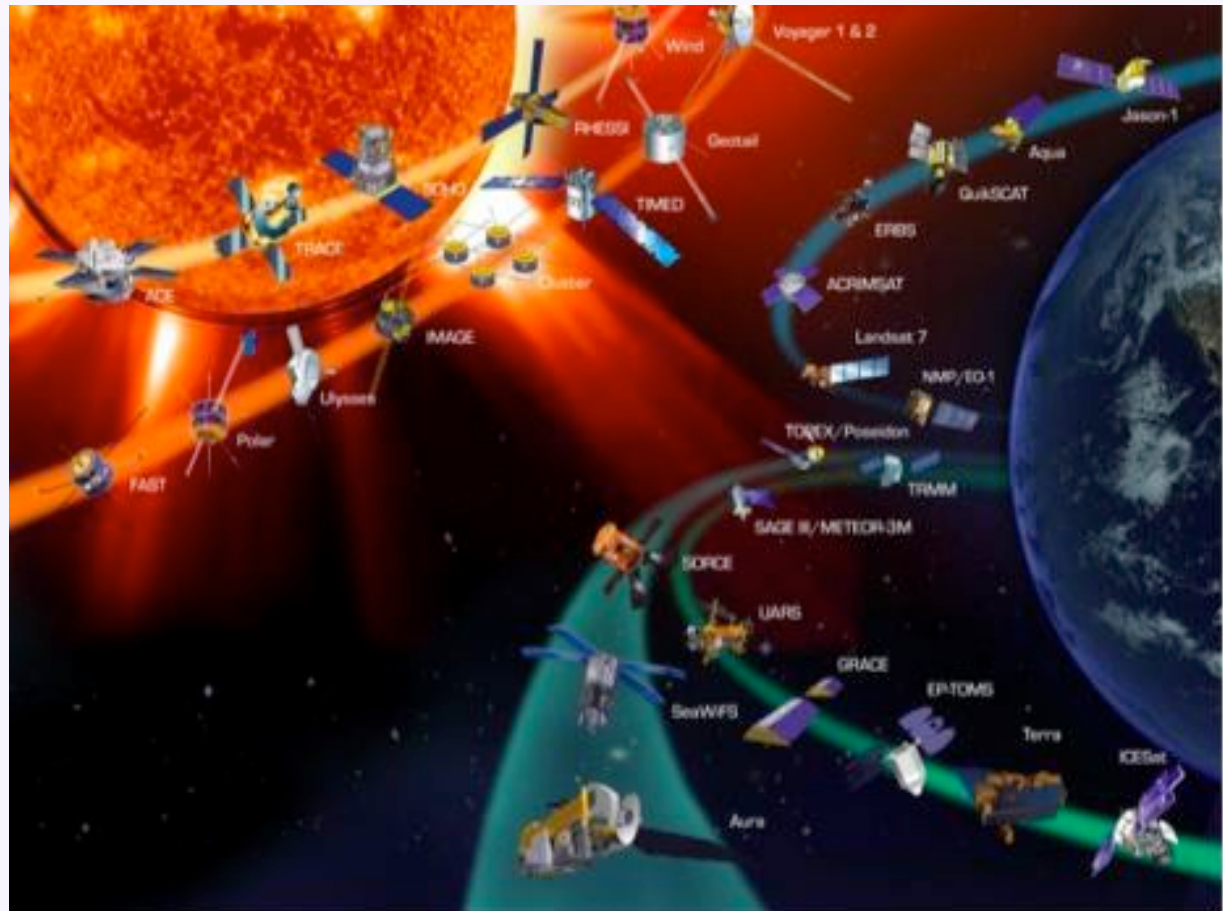
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# The VHO Team

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# Why Virtual Observatories ?

- Many datasets with large volumes
- Data sites distributed worldwide
- Stored in a variety of formats
- Accessible through a wide variety of interfaces



# Primary Purpose of VHO

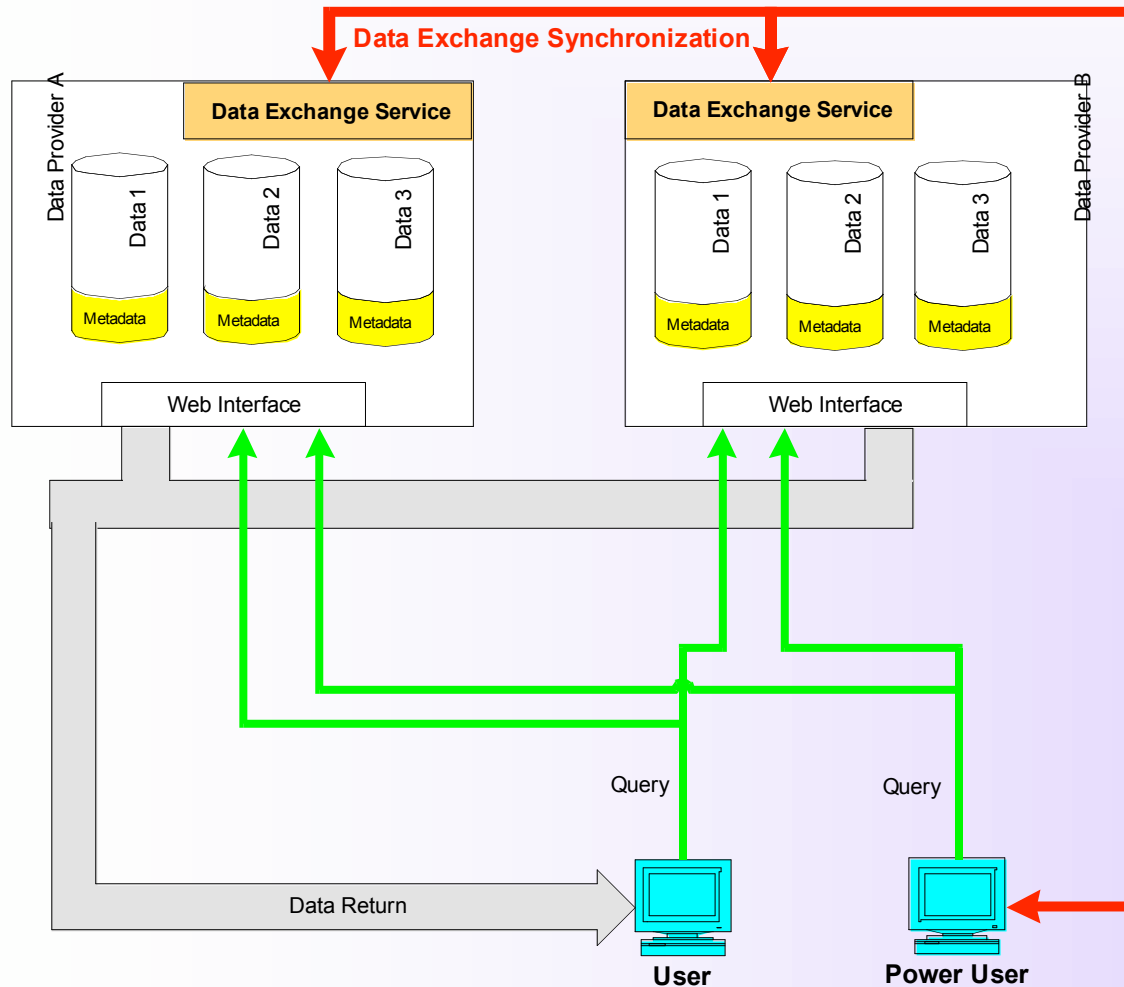
- Enable wider access to and use of the best quality heliospheric data.
- Enable complex queries on distributed data.
- Encourage the generation of new multi-instrument, multi-spacecraft data products.
- Provide common tools for data analysis.

# VHO Architecture

- Lightweight middleware with search capability.
- Common metadata description of products and services based on SPASE dictionary.
- Data exchange and synchronization mechanism.
- Minimum possible requirements on data providers.
- Low cost extensible system deployed in phases.

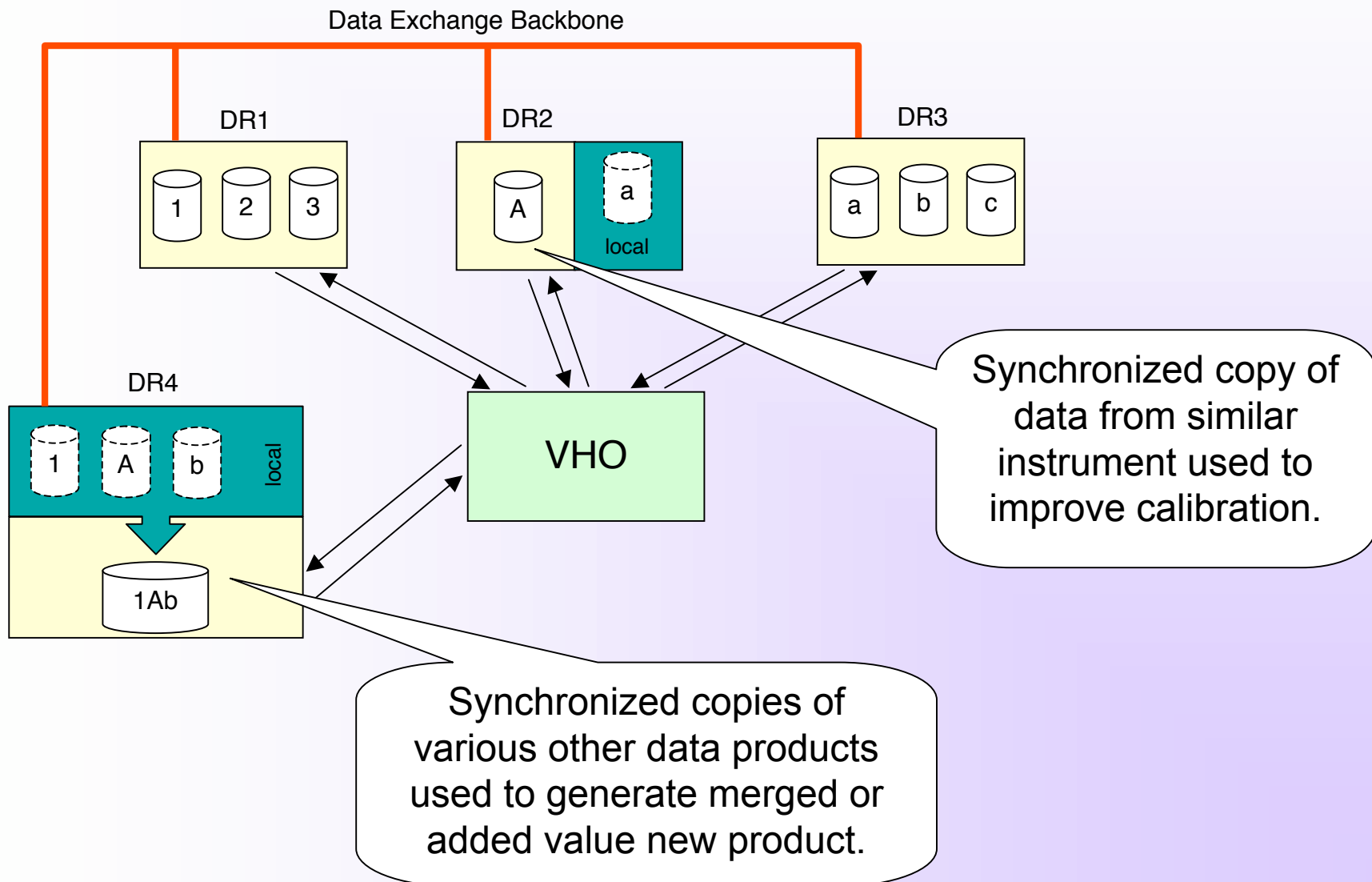
# VHO Development Phases (1)

## L1 Data Environment



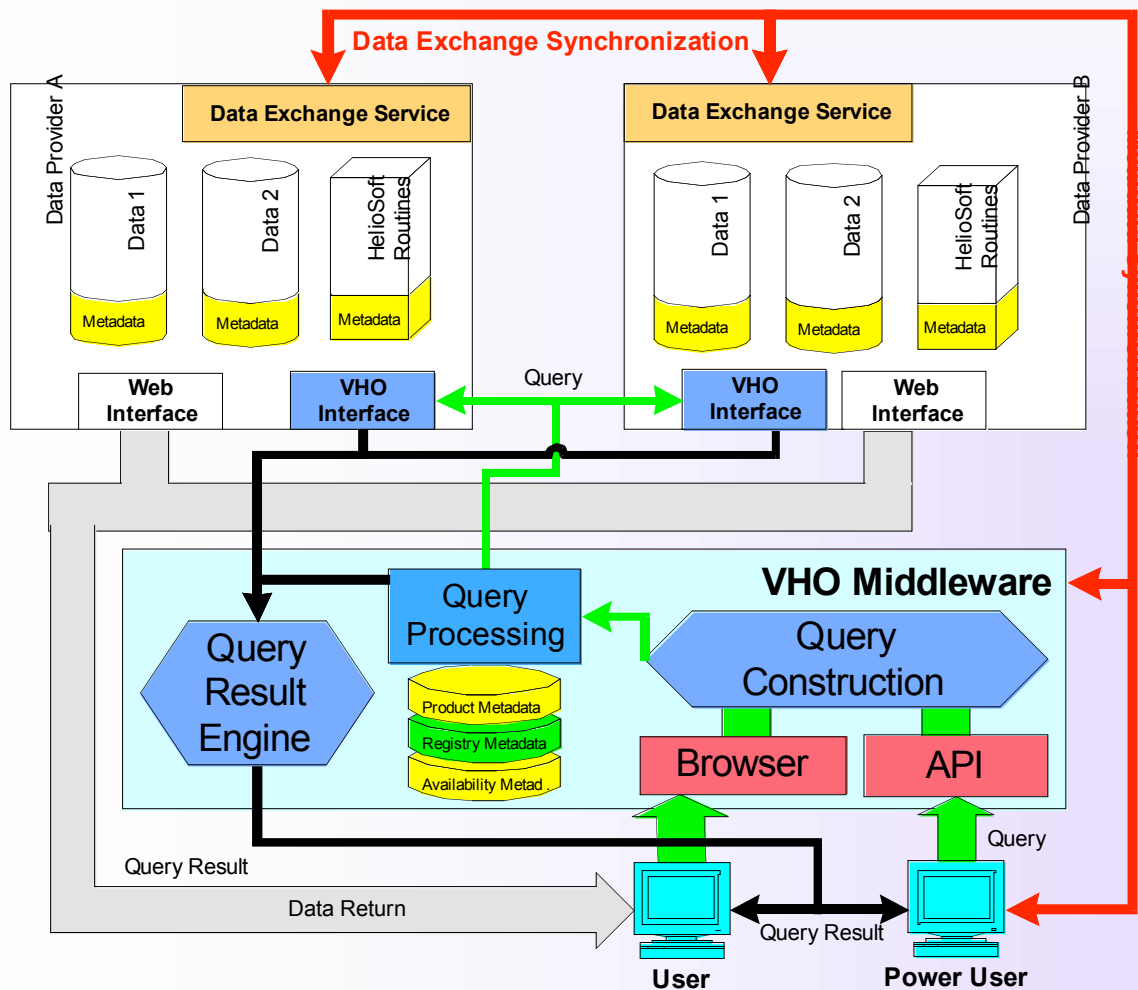
- L1 data sets made web accessible.
- Data products described in SPASE compliant metadata format.
- Data exchange synchronization established between data providers.

# Data Exchange Synchronization



# VHO Development Phases (2)

## Basic VHO

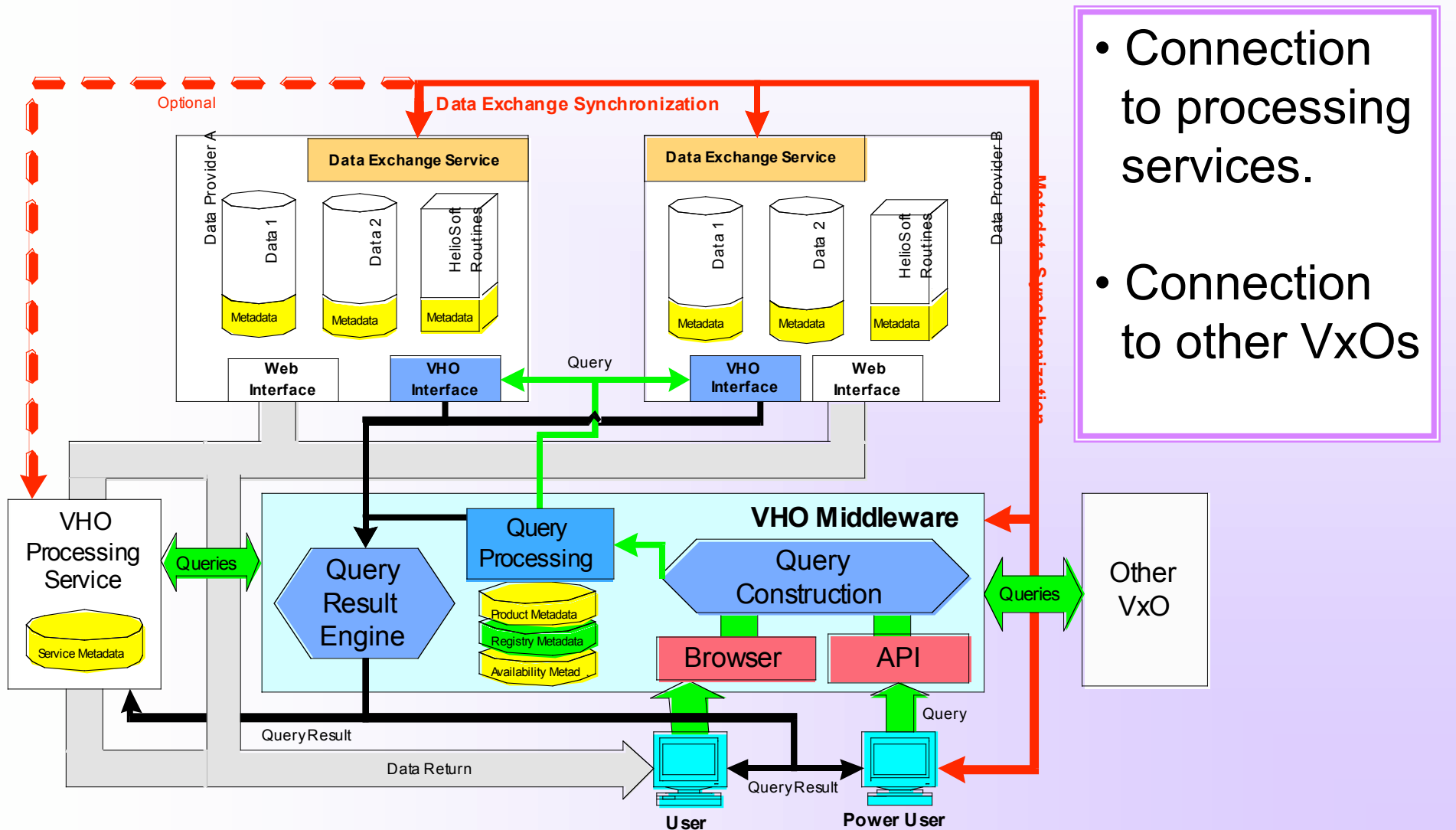


- Middleware with both Web and API user interfaces.
- VHO interfaces at data provider sites to facilitate complex queries.
- Public access to software tools with metadata.



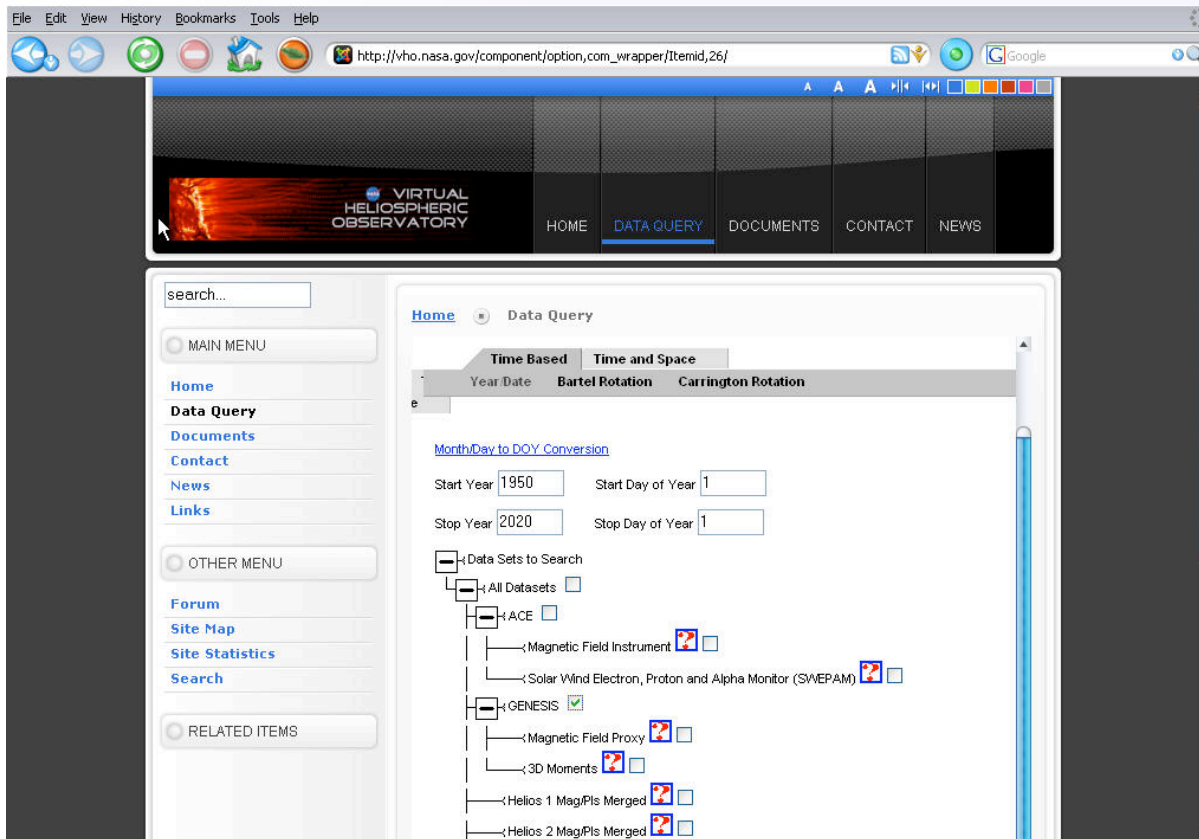
# VHO Development Phases (3)

## Full VHO



# Search Options

Data can be searched for by the following ways:



## Time

- Date/Time
- Bartel/Carrington Rot.

## S/C Location

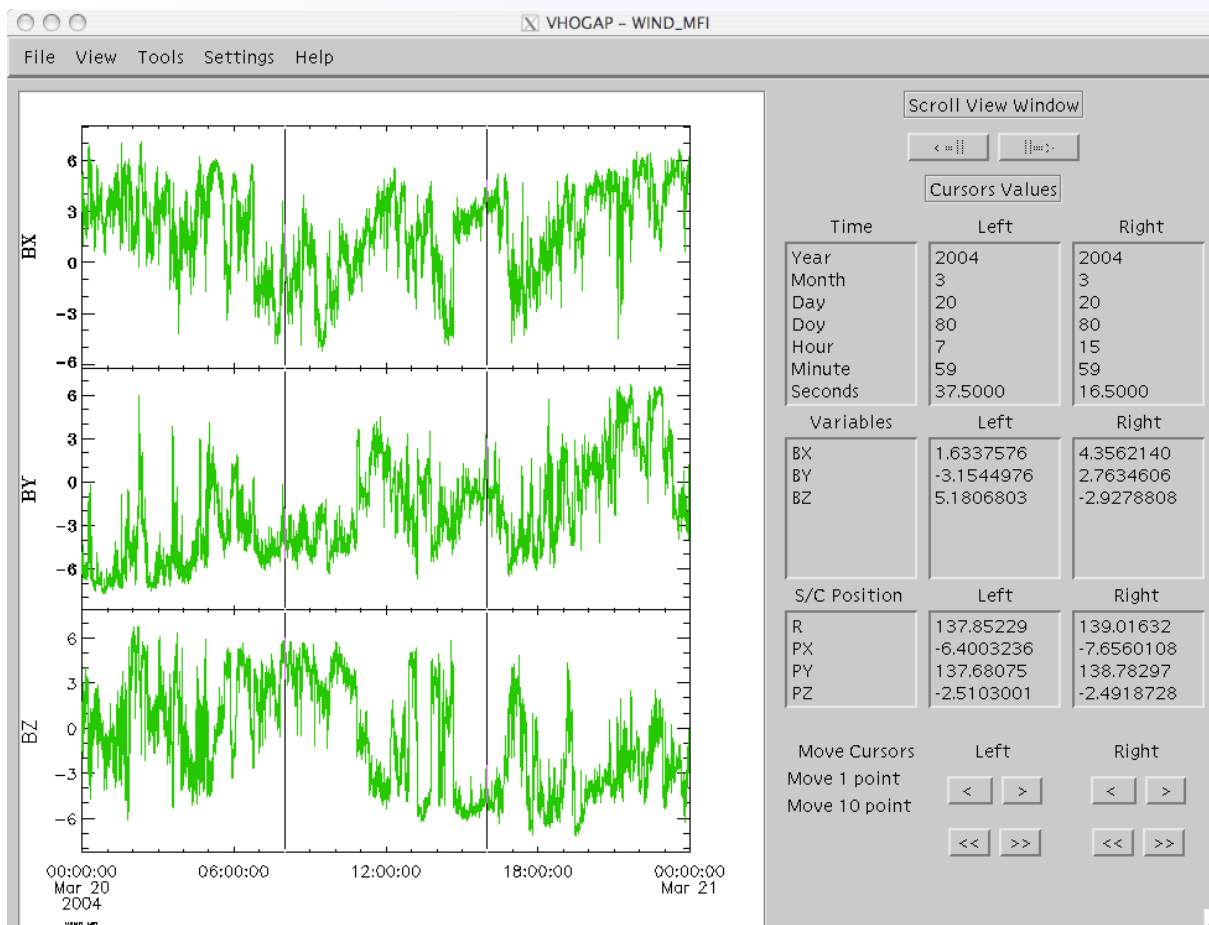
- GSE/GSM/HGI coord.
- Region name

## Measurement Type

- e.g., magnetic field, thermal plasma, energetic particles

# Demo VHO API

The VHO API can connect user written programs to VHO functionality without going through a browser.



An IDL Virtual Machine program, a Perl module and script, and a Java program are available from the VHO website to demonstrate the VHO API. The Demos allow search and simple visualization of data.

# HelioSoft

- During the early phases of VHO development, access is provided to IDL tools already developed by data providers (e.g., readers, simple visualization tools)
- IDL routines will be described in a standard metadata format.
- VHO will allow searches for these IDL routines.
- During later phases of VHO, a uniform data environment will be established that will allow seamless interaction of contributed routines.
- The HelioSoft library will be populated by the user community.

# VxO Interaction

- The various discipline VxOs will not be developed along the same blueprints. Therefore, some means of interaction between them will have to be established.
- The VxOs are much like web services. A VxO query language and registry of VxO capabilities is currently being developed.
- Passing queries and query results between VHO, VSO, VSPO and VMO will be demonstrated allowing searches that are not discipline specific.

# VHO Metadata

Static Metadata (requiring no or infrequent updates)

- Product Metadata – Complete description of data content.
- Registry Metadata – Data service information
- VHO Metadata – Description of VHO functionality.

## Dynamic Metadata

(requiring daily updates)

- Availability – Current range of available data.
- Software – Current list of available software tools.

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  <ParameterKey>BF1</ParameterKey>
  <Description>Average of the magnetic field magnitudes
(F1)</Description>
  <Caveats>This parameter is an average of high-time-resolution
field magnitudes</Caveats>
  <Cadence>PT01M</Cadence>
  <Units>nT</Units>
  <UnitsConversion>1.0e-9<T</UnitsConversion>
  <Dimension>
    <Size>1</Size>
    <Description>N by 1 dimensional array where N is the number
of observations    </Description>
  </Dimension>
  <Measured>
    <Field>
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      <FieldQualifier>Magnitude</FieldQualifier>
      <FieldQuantity>Magnetic</FieldQuantity>
    </Field>
  </Measured>
</PhysicalParameter>
```

# Data Provider Requirements

- The VHO is designed to minimize requirements on data providers. The VHO will work with any currently available data formats or services.
- The VHO team will assist data providers in the one-time generation of the detailed product metadata.
- Data providers will have to allow access to their products. Standard HTTP or FTP access is all that is required.
- Data providers will have to allow the VHO synchronization routines to run on their machine providing metadata updates.

# Community Input

- The VHO team is actively seeking community input to improve the functionality of VHO.
- Submit recommendations via our web page:  
<http://vho.nasa.gov>
- Bi-annual VHO meetings at AGU conferences.
- VHO team membership is open to volunteers.